MODULAR STORAGE RACK

CROSS-REFERENCES TO RELATED APPLICATIONS

This is a non-provisional application based on and claiming the filing priority of co-pending provisional patent application Serial No. 60/446,925, filed February 10, 2003.

BACKGROUND OF THE INVENTION

The present invention relates to storage racks used in warehousing and more particularly to a storage rack wherein modular pallet carriers convey pallets back or through a storage bay having a multiple pallet depth.

Warehouse storage racks typically comprise a frame structure divided into rows and columns that define storage bays for depositing storage units (e.g., pallets) of products to be stored. In order to conserve space in a storage facility, storage bays are sometimes more than one pallet deep. Movable carriers mounted on tracks are sometimes used to permit pallets to be moved to rearward storage locations from a single loading station at the front of the rack system. One such rack system is a "push back system" or "roll back system", wherein pallets are loaded at a front of the storage bay and pushed rearwardly by the next pallets as they are loaded on the rack. Then the pallets are unloaded from the front of the storage bay on a last in, first out basis. In another storage rack system, pallets are loaded at one end of the storage bay and pushed through the storage bay and unloaded from the other side of the storage bay. These are called "flow through systems."

A push back or roll back system is disclosed in Applicant's U.S. Patent No. 6,431,378 B1, which is incorporated herein by reference. One of the embodiments disclosed in this patent is a modular system wherein modular track sections are mounted in a storage rack and interconnected to

provide a push back type of rack (see FIGS. 22-44). An object of the present invention is to provide an improved modular rack system that is adaptable to either a flow-through system or a push back system.

For purposes of illustration, a flow-through system will be described. The end of the storage bay where goods are loaded on to the rack will be referred to as the front of the rack, whereas the opposite end of the rack where goods are unloaded will be referred to as the rear or back end of the rack. Goods moving in a forward direction through the rack are goods moving from front to the rear of the storage bay.

SUMMARY OF THE INVENTION

A modular storage rack in accordance with the present invention, ~~a modular storage rack~~ is mounted in a frame defining at least one storage bay having a depth sufficient to accommodate a plurality of separate storage units in separate horizontally spaced sections of the storage bay. The frame comprises cross beams between the ends of adjacent sections of the storage bay. A plurality of modular carriage units extend end to end across the storage bay. Each carriage unit includes an endless loop oval track section with spaced, interconnected wheeled carrier members being connected in an endless loop and mounted for movement around the track section. Each carriage unit extends into proximity to the cross beams at the ends of a storage bay section. Mounting brackets interconnect the ends of the track sections with adjacent cross beams so as to suspend the carriage units between the beams on opposite ends of the storage bay sections. A transfer assembly is mounted in the frame between adjacent ends of adjacent carriage units. The transfer assembly comprises cylindrical members mounted for rotation about a transverse axis and positioned with an upper side of the cylindrical members being substantially at the same level as the upper side of the

carriage units, such that the cylindrical members maintain storage units at a substantially level plane as they are transferred from one storage unit to the next adjacent storage unit.

The transfer assembly includes a transverse support member that extends over a cross beam, sometimes with reinforcement, with the cylindrical members being rotatably mounted in the support member. The support member is mounted to opposing ends of adjacent carriage units by brackets. The cylindrical members can be rollers or wheels or the like.

The carriage units can be separate units mounted on each side of the storage bay or a single carriage unit that extends all the way across the bay.

In one embodiment of the invention, the transfer assembly includes at least three longitudinally spaced cylindrical roller members positioned between the ends of adjacent track sections, the cylindrical members being positioned to engage storage units and modulate the speed of the storage units as they are transferred from track section to track section in the storage bay. In another aspect of the invention, the transfer assembly includes a single row of wheels.

In one aspect of the present invention, the carriage units are supported by saddle members mounted on the cross beams, the saddle members engaging and supporting ends of the track sections, and the track sections being releasably fastened to the saddle members. In another aspect of the present invention, the carriage units are attached to the cross beams by brackets mounted on the track sections, the brackets resting on the cross beams and being releasably fastened to the cross beams. At least one bracket permits longitudinal position adjustment. The rack includes a stop plate at an end of the storage bay to prevent storage units from falling off the end of the bay. An upwardly ramped plate is positioned adjacent an inner side of the stop plate. This slows the storage unit down before it hits the stop plate as the storage unit slides upwardly on the ramped plate.

The carriage members of the present invention preferably include plate members having horizontal storage unit support surfaces, the plate members being downwardly inclined at opposite sides of the support surfaces so as to provide close clearance between the plate members and the transfer assembly when the plate members move around arcuate sections of the track at the ends thereof.

These and other features, objects, and benefits of the invention will be recognized by one having ordinary skill in the art and by those who practice the invention, from the specification, the claims, and the drawing figures.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a side elevational view of a first embodiment of a storage rack employing a modular flow through pallet support mechanism constructed in accordance with the present invention.

FIG. 2 is a perspective view of the rack and pallet support mechanism of FIG. 1, taken from the rear end of the support mechanism.

FIG. 3 is a perspective view of the front end of the pallet support mechanism of FIG. 1.

FIG. 4 is a perspective view of the front support mechanism of FIG. 3, taken from the rear side thereof.

FIG. 5 is a perspective view showing three aligned modular carriage units of the flow through system mounted on spaced cross beams of the storage rack.

FIG. 6 is a perspective view of one of the modular carriage units of FIG. 5.

FIG. 7 is a perspective view showing the junction between adjoining carriage units mounted on the same intermediate cross beam, and showing a pallet transfer assembly mounted between the ends of the adjacent modules.

FIG. 8 is a perspective view similar to FIG. 7, taken from a different perspective.

FIG. 9 is a perspective view of the pallet transfer assembly of FIG. 8.

FIG. 10 is a perspective view similar to FIGS. 7 and 8, showing the manner in which adjacent carriage unit modules are mounted to a crossbeam by means of a saddle assembly.

FIG. 11 is a perspective view similar to FIG. 10, taken from a different perspective.

FIG. 12 is a perspective view showing the saddle assembly from a different perspective.

FIG. 13 is a perspective view showing the manner in which the end of a carriage unit module is attached to the rear end of a storage bay.

FIG. 14 is a perspective view of a second embodiment of the present invention wherein the pallet support mechanism comprises a single pallet carriage mechanism that extends the width of the storage bay, the perspective view in FIG. 14 showing the rear end of the pallet support mechanism.

FIG. 15 is a perspective view of the pallet support mechanism of FIG. 14, taken from the forward side of the rear end of the system.

FIG. 16 is a perspective view of the rear end of the pallet support mechanism of FIG. 15, showing the manner in which the rear carriage unit module is attached to the rear load beam of the storage rack.

FIG. 17 is a perspective view of the pallet support mechanism of FIG. 14, taken from the side of the pallet support mechanism and showing the use of elongated cross braces that extend between spreader support brackets attached to each of the spaced left and right track sections.

FIG. 18 is a perspective view of the pallet support mechanism of FIGS. 14-17, showing the manner in which the end of one carriage unit module is mounted on a horizontal cross beam.

FIG. 19 is an enlarged view of the connection between the modular carriage unit of FIG. 18 and the horizontal cross beam, showing the use of a welded bracket to the end of a track.

FIG. 20 is a perspective view showing the connection between a modular carriage unit of FIG. 14 and a horizontal cross beam, employing a bracket that is bolted to the carriage unit as opposed to being welded to the carriage unit and showing the end of the pallet transfer assembly employed with this embodiment of the invention.

FIG. 21 is a perspective view of the pallet support mechanism of FIG. 14, showing the pallet transfer assembly employed in that embodiment of the invention.

FIG. 22 is an enlarged perspective view showing one of the roller assemblies of the pallet transfer assembly of FIG. 21.

FIG. 23 is a different perspective view of one of the roller assemblies of the pallet transfer mechanism of FIG. 21, showing a clearance gap of about 1/8 inch between the end of the roller assembly and the end of the carrier member.

FIGS. 24A, 24B, and 24C are side elevational, right hand edge, and top views of the outer spreader support bracket of the present invention.

FIGS. 25A, 25B, and 25C are a front elevational view, right hand edge view, and top view of a slide mounting bracket of the present invention.

FIG. 26 is a cross sectional view of the pallet storage mechanism of FIG. 14, facing the front end of the storage bay.

FIGS. 27A, 27B, and 27C are a top view, front end view, and side view of the roller transfer assembly of the embodiment of FIG. 14.

FIGS. 28A, 28B, and 28C are a front edge view, top view, and end view of the carrier of FIG. 14, with the end of the carrier being removed to show the interior thereof.

FIG. 29 is an end view of the carrier of FIG. 14.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, an exemplary warehousing storage rack system 10, shown in FIG. 1, comprises a frame or rack 12 consisting of spaced vertical columns or uprights 14 and horizontal cross beams 16 that define a series of vertically and horizontally spaced storage bays 18. A single storage bay is shown in FIG. 1, with the storage bay comprising a front section 18A, three intermediate sections 18B, and a rear section 18C. Each storage bay section is positioned one behind the other and is sized to accommodate a standard size of storage unit. The storage unit is commonly a pallet 19, which is loaded in the storage bay by a forklift truck. Pallet 19 supports products or goods that are being stored in the rack. A typical pallet is about 40 inches wide and about 48 inches long and about 5 inches tall. For exemplary purposes, a rack designed to accommodate a standard pallet is illustrated. The horizontal cross beams 16 at the bottom of storage bay 18 include front and rear load beams 16A and 16B respectively and intermediate beams 16C, which typically are box beams, I beams, or C-shaped beams. The cross beams are bolted to the uprights by brackets 17 at the ends of the beams in preformed spaced holes in the uprights. The beam brackets 17 have holes spaced at one inch intervals and the uprights have holes spaced two inches apart. Thus, a flow-through system 20 illustrated in FIG. 1 can be mounted at an inclined angle simply by mounting the cross beams at different heights in the mounting holes.

A first embodiment of a flow-through system 20 comprises a movable pallet carriage mechanism 22 mounted on the horizontal beams 16 at the bottom of the storage bay and extending

in a longitudinal direction between the front and the back of the bay. The carriage mechanism shown in FIGS 2-13 includes two laterally spaced rows of aligned, modular carriage units 24. Each carriage unit 24 is mounted at front and rear ends thereof to cross beams 16. Each carriage unit module includes a series of wheeled carriers 25 pivotally interconnected by links 38 so as to form a continuous loop that is positioned on a generally oval track 26 which is also formed in the shape of a continuous loop. Track 26 includes a pair of laterally spaced left and right track sections 27 having opposed G-shaped cross sections with open sides of the track sections facing each other. Each track section 27 includes an upper support rail 28, a lower support rail 30, and a curved section 32 at each end interconnecting the upper and lower support rails into an oval loop. The upper and lower rails of each track section are spaced apart by spreader support brackets 33 welded to the rails. The left and right track sections are connected together by cross braces 35 that extend between spreader support brackets. The whole assembly of spaced track sections is thus one integral unit.

The wheeled carrier members 25 each comprise a horizontal support surface 41, with side flanges 43 extending downwardly from opposite sides thereof. Wheels 36 are mounted on outer sides of each side flange and ride in the left and right track sections 27.

Referring to the embodiment shown in FIGS. 2-13, this pallet support mechanism employs two rows of aligned modular carriage units 24 on each side of the storage bay 18. Pallet 19 is suspended between the two rows of modular carriage units. The rear end of the flow-through system includes a pair of stop plates 44 bolted to cross beam 16B and extending upwardly so as to stop the pallet when it comes to the end of the track.

The front end of the carriage mechanism includes plate 46 that is bolted to cross beam 16A and extends upwardly therefrom and then has an inclined upper surface 48 that extends

rearwardly. The inclined surface prevents a pallet from damaging the front end of the pallet support mechanism and causes the pallet to be cammed upwardly on top of the pallet support mechanism.

The manner in which modular carriage units 24 are mounted in the storage bay is shown in FIGS. 4-8. Referring to FIG. 5, a carriage unit module 24 is integrally formed as a unit with oval left and right track sections 27 on each side thereof and with the carrier members pivotally interconnected in an endless loop being mounted to the two track sections and being positioned between the track sections. Each end of the modular unit 24 extends relatively closely to the cross beam at each end of the pallet position in the bay. The curved end of each unit is mounted to the cross beam in the embodiment shown in FIG. 5 by means of a saddle 50 welded to the cross beam and having arms 52 having arcuate upper surfaces 54 extending outwardly therefrom. Brackets 56 bolted to the outer ends of the arms and to the track hold the track in a nested position against the saddle. This construction is employed at all intermediate beams along the length of the pallet support mechanism.

An important feature of the present invention is the incorporation of a pallet transfer assembly 58 between each adjacent section of the modular carriage assembly. Pallet transfer assembly 58 includes a bracket 60 bolted to the upper ends of each adjacent track module, with a wheel support frame 62 extending between the brackets and with a plurality of wheels 64 being rotatably mounted in the wheel support frame for rotation about a transverse axis. The upper plane of the wheels is at the same level as the upper plane of the support surfaces of the carrier members. Without the wheels, when the pallets reach the end of each carriage unit, the ends of the pallets tend to drop downwardly somewhat and then engage the next adjacent carriage unit partially in the side of the unit. This can cause the pallets to stop their even flow along the pallet support mechanism. The wheels of the transfer mechanism cause the pallets to flow smoothly from one modular section

to the next. The wheels also have another advantage, in that they tend to slow the movement of the pallets along the pallet support mechanism. When the pallets are on the wheeled carrier members, they tend to pick up momentum and increase speed, but when they engage the transfer mechanism, some of the momentum is absorbed by the transfer mechanism and the pallets tend to slow down. This causes a natural modulation of the speed of the pallets along the carrier mechanism.

The manner in which the modular tracks are mounted at the ends of the pallet support mechanism is shown in FIG. 13. An end bracket 66 is attached to each track section 27 at the end of the rack. End bracket 66 has a slot that fits over upper flange 68 of C-shaped end cross beam 16B. An outwardly extending flange 70 at the end of a portion of end bracket 66 below the slot 70 in the end of end bracket 66 is bolted to the vertical portion of beam 16B to securely hold the carriage unit module to the end of the rack.

As shown in FIG. 4, the front end of the front module is connected to the front cross beam 16A in the same manner as the rearmost module is attached to the rear cross beam. End bracket 74 welded to the end of the track fits over flange 76, and the outer end of flange 74 is attached to the vertical portion of beam 16A.

The shape of the upper surface of carrier members 34 also is important in the smooth flow of the pallets from one modular section to the next. Carrier members 34 have a flat upper surface that is horizontal when the carrier members are positioned on a level stretch of track. Front and rear edges 78 of support surfaces 41 are inclined downwardly at an angle of approximately 45 degrees. This causes the outer edges of the support surfaces to miss the wheel support frame 62 and yet permit the support surface 41 of the carrier members to pass quite close (within 1/8 inch) of the wheel support frame. The inclined edges of the carrier support surfaces also reinforce the strength of the carrier support surfaces and resist bending of the surfaces under the weight of a pallet.

The installation and removal of each modular section is relatively simple. The modular section is simply dropped into place and bolted to the saddles or front and rear beams 16A and 16B at the ends of the track. The bolt fasteners are mounted in slots to some extent in order to provide some adjustment.

Another embodiment of the present invention is shown in FIGS. 14-29. In this embodiment, instead of two parallel tracks on opposite sides of the bay, a single module 80 of the pallet support mechanism extends for the full width of the bay, with left and right track sections 82 being positioned adjacent the outer sides of the bay and with wider carrier elements 84 extending between the two track sections across the entire width of the bay. The track sections are substantially the same as the track sections in the previously embodiment. Track spreader support brackets 86 extend between upper and lower rails at spaced locations along the rails in order to reinforce the rails and maintain proper separation between the rails. The construction of the spreader support brackets is shown in FIGS. 24A –24C.

Cross braces 88 extend between spreader support brackets on opposite sides of the track in order to maintain the lateral spacing of the separate track sections 82. The previous embodiment also employs braces between the track spreader supports, but the braces are of course shorter.

While the track sections 82 of the full width modules 80 can be attached to the cross beams in the same manner as the previous embodiment, an alternative fastening method is shown in FIGS. 16-20. This alternative fastening method can also be used in the previous embodiment.

In FIG. 16, the end of the rearmost track section is attached to rear cross beam 16B by means of a mounting flange 90 that is bolted (as opposed to being welded) to the track section by bolts 92 that ride in adjustable slots 94. This permits some adjustment of the bracket to accommodate beams that are mounted in somewhat different positions.

The manner in which intermediate sections of track modules are attached to intermediate cross beams is shown in FIGS. 18-20. A welded side bracket 96 is attached to the front end of module 80 in FIG. 18 and this bracket is bolted to the cross beam 16C. An outwardly extending flange 98 on the upper side of the side bracket rests on the top of the cross beam.

On the other side of the same beam, the rear end of the module on that side is attached to the same cross beam (by the same bolts) by a bracket 100 that is bolted to the track by means of adjustable slots 102. This permits the brackets to be adjusted so that variations in distances can be accommodated. Upper edges of the brackets rest on the beam. It is desired to have the side brackets on one module be welded and the side brackets on the adjacent module be bolted so as to permit some adjustment while retaining necessary rigidity.

The full width modules employ a transfer assembly 104 that is somewhat different from the transfer assembly of the more narrow modules. Transfer assembly 104 includes three spaced rollers 106 approximately six inches long at three lateral locations along the width of the pallet support mechanism and positioned between adjacent ends of carriage modules. The upper surfaces of the rollers are positioned at the same plane as the upper support surface of the carrier members. As with the previous embodiment, the rollers are mounted on a transverse support frame 108, and the support frame is mounted to the tracks on both sides of the transfer mechanism by brackets 110. The rollers are positioned so that they come within 1/8 of an inch from the carrier members as they pass downwardly around the curved end of the modules.

The horizontal support surface 113 of the carrier members 112 also is somewhat different in this embodiment. As in the previous embodiment, the front and rear trailing edges 115 of the support surfaces are inclined at an angle of 45 degrees in order to permit the support surfaces to come as close to the rollers without hitting them. In order to reinforce the elongated support

surfaces from sagging under weight, a reinforcement channel 114 extends laterally along the length of the elongated carrier support surface, as shown in FIG. 28C.

Because the roller transfer assembly is also subjected to a substantial bending force when pallets pass over the roller transfer assembly, the roller transfer assembly is also reinforced to prevent sagging. The central roller in the roller transfer assembly is mounted in an upwardly facing U-shaped channel 116, and a V-shaped reinforcement member 118 is mounted on the bottom of the channel. The reinforcement member rides on the top of cross beam 16C and thus prevents the rollers from sagging under the weight of pallets passing over the rollers.

As in the previous embodiment, the roller transfer assembly also serves to dampen the momentum of pallets as they pass from one modular section to the next, thus impeding any increase in speed as the pallets roll along the pallet support mechanism. The position and height of the rollers insures that the pallets flow smoothly from one modular section to the other.

It should be understood that the foregoing is merely exemplary of the preferred practice of the present invention and that various modifications in the arrangements and details of the construction disclosed herein may be made without departing from the spirit and scope of the present invention.